UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/628,316	07/28/2003	Jeanette E. O'Hara	GMC 0048 PA/40360.53/GP-3	4452

7590 11/29/2006

Killworth, Gottman, Hagan & Schaeff, L.L.P.
Suite 500
One Dayton Centre
Dayton, OH 45402-2023

EXAMINER	
LEE, CYNTHIA K	
ART UNIT	**PAPER NUMBER**
1745	

DATE MAILED: 11/29/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)
	10/628,316	O'HARA, JEANETTE E.
	Examiner	**Art Unit**
	Cynthia Lee	1745

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on 06 October 2006.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) 1-24,26-45,47 and 48 is/are pending in the application.

4a) Of the above claim(s) 47 is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) 1-24,26-45 and 48 is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

Response to Amendment

This Office Action is responsive to the amendment filed on 10/6/2006. Claims 25 and 46 have been canceled and claims 47 and 48 have been added. Claims 1-24, 26-45, 47, and 48 are pending. Claim 47 is withdrawn from further consideration as being drawn to a non-elected invention. Claims 1, 27, and 36 have been amended.

The 35 USC 112, 2nd paragraph rejection has been withdrawn.

Applicant's arguments have been fully considered and are persuasive. However, upon further consideration, the instant claims are rejected under new grounds of rejections and thus, claims 1-24, 26-45, and 48 are finally rejected for reasons necessitated by applicant's amendment.

Election/Restrictions

Newly submitted claim 47 is directed to an invention that is independent or distinct from the invention originally claimed for the following reasons: Claim 47 is a combination whereas the previously examined claims were drawn to a subcombination. Claim 47 is distinct from the originally presented claims because the vehicle does not require all the particulars of the subcombination (see for example, claims 2-23). Also, claim 47 is classified in class 180, subclass 165. Because these inventions are independent or distinct for the reasons given above and there would be a serious burden on the examiner if restriction is not required because the inventions have acquired a separate status in the art in view of their different classification, restriction for examination purposes as indicated is proper. Further, because these inventions are independent or distinct for the reasons given above and there would be a serious

burden on the examiner if restriction is not required because the inventions require a different field of search (see MPEP § 808.02), restriction for examination purposes as indicated is proper.

Since applicant has received an action on the merits for the originally presented invention, this invention has been constructively elected by original presentation for prosecution on the merits. Accordingly, claim 47 is withdrawn from consideration as being directed to a non-elected invention. See 37 CFR 1.142(b) and MPEP § 821.03.

Claim Rejections - 35 USC § 112

The following is a quotation of the first paragraph of 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

Claims 1-24, 26-45 and 48 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the enablement requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention. The Examiner notes that "a device configured to convert a hydrogenous fuel source to electrical energy" is interpreted to mean an electrical energy generating device, i.e. a fuel cell. Claim 1 recites that the "humidified reactant output exceeds about 150%" and claim 27 recites that "said humidified reactant output is between about 100% and about 150%." No guidance is given is the disclosure as to how this is accomplished because a fuel cell generates electrical energy, not supersaturate

reactant output gases. Further, it is unclear how a fuel cell can operate to yield supersaturated reactant output gas because it is an unstable state.

su•per•sat•u•rate

---

verb To cause (a chemical solution) to be more highly concentrated than is normally possible under given conditions of temperature and pressure.
Other Derivatives: su‚per•sat‚u•ra‚tion, *noun*

The American Heritage® Concise Dictionary, Third Edition, © 1994 by Houghton Mifflin Company

APA | MLA | Chicago : **Citing this entry**
supersaturate. The American Heritage® Concise Dictionary (1994). Retrieved 10 November 2006, from xreferplus. http://www.xreferplus.com/entry/718872

Also,

supersaturation

The condition in which a solvent contains more dissolved matter (solute) than is present in a saturated solution of the same components at equivalent temperature. Such solutions may occur or can be made when a saturated solution cools gradually so that nucleating crystals do not form. They are extremely unstable and will precipitate upon addition of even one or two crystals of the solute or upon shaking or other slight agitation. Supersaturated solutions occur in the confectionery industry, e.g., in fudges, maple sugar, etc.

Hawley's Condensed Chemical Dictionary, 14th Edition
Copyright ©2002 by John Wiley & Sons, Inc.

Moreover, the limitation in claim 23 “relative humidity of said humidified reactant output is about 300%” appears a bit high. If supersaturation of 300% is possible in a fuel cell, amount of direction and guidance are lacking in the disclosure.

Further, it is known in the art that supersaturation of the outlet gas is undesirable because water condenses to block the polymer membrane electrolyte pores to prevent the diffusion of reactant pores (see Enami US 5922485, 2:50-60). Thus, it is unclear to the Examiner how the Applicant's diffusion media functions with supersaturated outlet gases.

Hence undue experimentation would be required to determine how supersaturation is achieved and practiced and how the diffusion media functions properly in the applicant's invention as claimed.

With respect to enablement commensurate in scope with the claims, section 2164.08 of the MPEP states:

> "The Federal Circuit has repeatedly held that 'the specification must teach those skilled in the art how to make and use the full scope of the claimed invention without undue experimentation'. In re Wright, 999 F.2d 1557, 1561, 27 USPQ2d 1510, 1513 (Fed. Cir. 1993)... The determination of the propriety of a rejection based upon the scope of a claim relative to the scope of the enablement involves two stages of inquiry. The first is to determine how broad the claim is with respect to the disclosure. The entire claim must be considered. The second inquiry is to determine if one skilled in the art is enabled to make and use the entire scope of the claimed invention without undue experimentation."

Factors to be considered when determining whether the claimed invention would require undue experimentation are given in MPEP 2164.01 (a). In re Wands, 858 F. 2d

731, 737; 8 USPQ 2d 1400, 1404 (Fed. Cir. 1988). Only the relevant factors will be addressed for determining undue experimentation of the presently claimed invention. The relevant factors are (A) the breadth of the claims; (B) the amount of direction provided by the inventor; (C) the existence of working examples, and (D) the level of predictability in the art.

Factor (A) Breadth of the claims:

No guidance is given in the specification as to how a reactant output of an energy generating device is supersaturated because a fuel cell generates electrical energy, not supersaturate reactant output gases.

No guidance is given as to how the fuel cell membrane would be kept moist when the gas is supersaturated. No guidance is given as to how the reactant gases diffuse through the diffusion media when the supersaturated gas condenses to block the diffusion media pores.

Factor (B) The amount of direction provided by the inventor.

Applicant gives no guidance as to how supersaturation that exceeds 150% is achieved by the controller.

The specification (pg 6) further states that "Of course, in the event humidity regulation elements are employed in the fuel cell device downstream of the diffusion media and prior to the humidified reactant output, the relative humidity measures expressed herein are given as if such humidity regulation elements are not present in

the device" (emphasis added). It is unclear how this is structurally accomplished within a fuel cell.

Further, it is unclear if supersaturation is a programming issue of a humidifier attached to a fuel cell, a programming issue of a fuel cell, or a functional configuration of the fuel cell. If it is a programming issue of the fuel cell or a functional configuration of the fuel cell, no guidance is given to guide one in the art how this is achieved.

Factor (C) The existence of working examples:

No working example is provided in the specification to guide one of ordinary skill in the art as to how to achieve supersaturation of the reactant outlet.

Thus, the claims are properly rejected for scope of enablement since the two stages of inquiry as set forth in MPEP section 2164.08 have been fully addressed herein by the Examiner.

The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claims 1-24, 26-45 and 48 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. Claim 1 recites that the "humidified reactant output exceeds about 150%" and claim 27 recites that "said humidified reactant output is between about 100% and about 150%." Claim 23 recites that the controller is

configured such that a relative humidity of said humidified reactant output is about 300%".

It is unclear what the Applicant is claiming. The Examiner is interpreting "a device configured to convert a hydrogenous fuel source to electrical energy" to mean an electrical energy generating device, i.e. a fuel cell. As currently amended, the reactant outlet is humidified exceeding the relative humidity of 150%. It is unclear how an electrical energy generating device controls the relative humidity ouputed by the reactant gas. Further, it is unclear how a fuel cell can operate to yield supersaturated reactant output gas because supersaturation is an unstable state.

The Examiner further notes that a controller cannot supersaturate a reactant gas. A controller is a programmable device that may be connected to a supersaturating instrument, such as a humidifier, to control the relative humidity.

Claim 9 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. The limitation "said hydrophobic" lacks antecedent basis.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 1-3, 5, 9-11, 15, 17, 20-24, 27-30, 33, and 48 are rejected under 35 U.S.C. 103(a) as being unpatentable over Barton (US 2003/0157397) in view of Andrews (US 2002/0110714), as evidenced by Yoshida (US 2003/0091891).

Barton discloses a fuel cell comprising a cathode gas and an anode gas. The fuel cell comprises a gas diffusion backing layer on a catalyst coated membrane. The gas diffusion backing comprises a porous carbonaceous paper having randomly oriented fibrils (applicant's claim 15). The gas diffusion backing further comprises a microporous layer adjacent the porous carbonaceous paper. The microporous layer consists essentially of a fluorinated polymer that contains carbon particles [0050, 0055]. The carbon particles can comprise graphite fibers [0069]. The fluorinated polymer comprises poly(vinylidene fluoride) and PTFE [0060] (applicant's claim 9). Carbon particles can be of any form that include, but not limited to Vulcan ® XC72, SP Carbon & Ensaco, and Applied Science Graphite Fibers (applicant's claim 3) with an average surface area of about 50 to 800 m2/g [0069] (applicant's claims 1, 2, 5, 27, 28).

Although Barton discloses an average surface area of about 50 to 800 m2/g [0069] (applicant's claims 1, 2, 27, 28), Barton does not disclose that the surface area is below about 85 m2/g, between 60 m2/g and 80 m2/g, between 200 m2/g and 300 m2/g, or about 250 m2/g. Barton discloses that carbon particles are used to impart good electrical conductivity [0069]. Barton further discloses that the selection of the particular carbon particles (e.g., size and aspect ratio) will influence the level of porosity, coating thickness, and conductivity, as will be appreciated by those skilled in the art. In general, thinner coatings and larger pore sizes will promote mass transport across the coating.

The formation of very large pores, however, tends to result in diminished contact between the carbon particles of the microporous layer and active regions of the catalyst, and thus reduces efficiency of a fuel cell for a given loading of carbon particles. Namely, there will be a need to employ routine experimentation to optimize the microporous layer for a particular application. [0083]. The surface area is directly related to particle size and Barton clearly discloses that the particle size is a result effective variable. It has been held by the courts that discovering an optimum value or workable ranges of a result-effective variable involves only routine skill in the art, and thus not novel. *In re Boesch*, 617 F.2d 272, 205 USPQ 215 (CCPA 1980). See MPEP 2144.05. Further, it has been held by the courts that where the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation. In re Swain et. al., 33 CCPA 1250, 156 F.2d 239, 70 USPQ 412.

The microporous layer in the gas diffusion backing so formed has a thickness of about 1 to 100 microns (applicant's claims 10, 11, 30), and a coating weight of a fluorinated polymer of 0.1 to 20 mg/sqcm. In order to be useful in fuel cells, the layer so formed has a network of open micropores providing channels for the passage of water and reactant gases from one side to the other. Typically the micropores will constitute about 50% to about 85% of the layer, by volume, and have a mean pore size in the range of about 0.01 to about 5 microns [0082].

Barton discloses using Toray TGP-H-060. Toray TGP-H-060 has a bulk density of 0.46 g/ml, a gas permeability of 30 mm Aq/mm, and an average thickness of about 180 microns (applicant's claim 17, 33, 42) [0096].

It is evidenced that the mean particle size of carbon Vulcan XC72 is about 30 nm, as evidenced by Yoshida [0131]. (applicant's claims 1, 27, 29).

Barton does not disclose a controller configured such that the relative humidity of said humidified reactant product exceeds about 150% (claim 1 and 48) and 100% (claim 27). However, Andrews teaches humidification of the fuel gas and oxidant gas is generally required for fuel cells that use solid polymer electrolyte membranes [0003]. Andrews teaches an apparatus for controlling the humidity of a gas stream such as a reactant gas stream and a fuel gas stream used in fuel cells. The specific water evaporation rate, gas delivery temperature, and the degree of gas humidity may be adjusted and maintained at predetermined levels [0023]. The amount of water vapor available for absorption by the gas steam can be varied up to the saturation point (applicant's relative humidity 100%) [0024]. The system also is equipped to determine when the system has exceeded the normal operation mode as a humidifier and has begun to operate in an undesirable boiler mode [0035]. The Examiner notes that since relative humidity above 100% is an unstable state, Andrew's apparatus is capable of achieving supersaturated state because when the apparatus makes a transition from a normal operating state to subnormal operating state, the reactant gas requires time to adjust to the subnormal state. At that instant, the reactant gas will be supersaturated before adjusting to the 100% saturation state of the subnormal state.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to add Andrews' apparatus to Barton's fuel cell for the benefit of appropriately humidifying the fuel cell to prevent the polymer electrolyte membrane from drying as well as flooding.

Claims 14, 18, 19, 32 and 34 are rejected under 35 U.S.C. 103(a) as being unpatentable over Barton (US 2003/0157397) in view of Andrews (US 2002/0110714), as evidenced by Yoshida (US 2003/0091891), as applied to claims 1 and 27, further evidenced by Cipollini (US 6379827).

Barton discloses all the elements of claims 1 and 27 and are incorporated herein. Barton does not disclose the porosity and the mean pore size of the carbon paper (applicant's diffusion media substrate). However, Barton discloses using Toray TGP-H-060. It is evidenced that Toray TGP-H-060 has porosity of about 65-75% (claim 32) and has a mean pore size of about 27 to 37 microns (applicant's claims 18, 19, 34), by Cipollini (5:30-45).

Further, since the pores in the microporous layer has porosity of about 50% to about 85% [Barton, 0082] and the carbon paper Toray TGP-H-060 has a porosity of about 65-75% (Cipolini, 5:30-45), limitation of claim 14 has been met.

Claims 7, 8, 12, 13, 31, and 35 are rejected under 35 U.S.C. 103(a) as being unpatentable over Barton (US 2003/0157397) in view of Andrews (US 2002/0110714), as evidenced by Yoshida (US 2003/0091891), as applied to claims 1 and 27 and incorporated herein.

Barton discloses all the elements of claims 1 and 27. Barton does not disclose that the microporous layer comprises greater than 80% of the carbon component. However, Barton discloses that the microporous layer comprises about 1 to 40 wt% carbon particles (applicant's carbon component), 1 to 20 wt% fluorinated polymer, and the balance being the dispersant or a solvent [0080]. Further, Barton discloses that typically, carbon particles are used to impart good electrical conductivity to the second layer (Barton's microporous layer) of the gas diffusion backing [0069]. It is clear that the amount of carbon particles affect the conductivity of the gas diffusion layer and thus, it would have been obvious to one of ordinary skill in the art at the time the invention was made to vary the carbon particle amount (applicant's carbon component) proportionally to appropriately control the conductivity (applicant's claims 7, 8, 35). It has been held by the courts that where the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation. In re Swain et. al., 33 CCPA 1250, 156 F.2d 239, 70 USPQ 412. Further, Barton discloses that carbon particles affect conductivity, thus clearly teaching that the amount of carbon particles is a result effective variable. It has been held by the courts that discovering an optimum value or workable ranges of a result-effective variable involves

only routine skill in the art, and thus not novel. *In re Boesch*, 617 F.2d 272, 205 USPQ 215 (CCPA 1980). See MPEP 2144.05.

Barton does not disclose that microporous layer infiltrates into the carbon paper to a depth of less than 5 um or 10 um. However, Barton discloses that the microporous layer will be coated or laminated directly onto the carbonaceous paper, and thus, be in electrically conductive contact [0055]. Further, since the carbon fibrous paper is porous, the microporous layer must necessarily microscopically infiltrate into the carbonaceous paper. Since Barton discloses that good electrical conductive contact must be present between the microporous layer and the carbon paper, it would have been obvious to one of ordinary skill in the art at the time the invention was made to vary and adjust the amount of infiltration for the benefit of attaining good adhesion between the two layers (applicant's claims 12, 13, 31).

Claims 4 and 6 are rejected under 35 U.S.C. 103(a) as being unpatentable over Barton (US 2003/0157397) in view of Andrews (US 2002/0110714), as evidenced by Yoshida (US 2003/0091891), as applied to claim 1 and incorporated herein, further in view of Larson (US 2003/0134178).

Barton discloses all the elements of claim 1. Barton discloses that the mean particle size of carbon Vulcan XC72 is about 30 nm, as evidenced by Yoshida [0131], but Barton does not disclose that the mean particle size is of about 42 (claim 4) nm. However, Larson teaches that carbon particles can be used for diffusion layer with

typically having an average particle size of 1-100 nm [0027]. Larson teaches that the gas diffusion membrane must be conductive yet must be able to allow the passage of reactant and product fluids [0019]. Further, the particle size correlates with surface area, and thus the available reactive area. Thus, it would have been obvious to one of ordinary skill in the art at the time the invention was made to adjust the carbon particle size for the benefit of easily mixing the microporous layer mixture and ultimately adjusting the particle size to control the fluid passage and reactive surface area. It is clear that the mean particle size is a result effective variable. It has been held by the courts that discovering an optimum value or workable ranges of a result-effective variable involves only routine skill in the art, and thus not novel. *In re Boesch*, 617 F.2d 272, 205 USPQ 215 (CCPA 1980). See MPEP 2144.05.

The fluorinated polymer comprises poly(vinylidene fluoride) and PTFE [0060]. Carbon particles can be of any form that include, but not limited to Vulcan ®, SP Carbon & Ensaco, and Applied Science Graphite Fibers. Although Barton does not expressly disclose a hydrophilic carbonaceous component comprising acetylene black (applicant's claim 6), acetylene black is commonly used as a conducting agent in the fuel cell art, as shown by Larsen [0027]. It has been held by the court that the selection of a known material based on its suitability for its intended use is *prima facie* obvious. Sinclair & Carroll Co. v. Interchemical Corp., 325 U.S. 327, 65 USPQ 297 (1945). Se MPEP 2144.07.

Claims 16 and 26 are rejected under 35 U.S.C. 103(a) as being unpatentable over Barton (US 2003/0157397) in view of Andrews (US 2002/0110714), as evidenced by Yoshida (US 2003/0091891) as applied to claim 15 and 48, further in view of Zuber (US 2002/0041992).

Barton discloses all the elements of claim 1 and are incorporated herein. Barton discloses that the porosity of the carbon paper is between 65-75%, as evidenced by Cipollini, but does not disclose that the porosity is above about 80%. However, Zuber teaches that the carbon substrate of the gas diffusion structure is preferably formed by a carbon fiber substrate with a porosity raging between 60 and 90% [0022]. Further, Zuber teaches that the gas diffusion structure facilitates good access by the reaction gases to the electrodes and efficient conduction of the cell current are applied to the electrodes [0004]. Thus, it would have been obvious to one of ordinary skill in the art at the time the invention was made to increase the porosity of the diffusion substrate for the benefit of enhancing good diffusion of the reactant gases.

Claims 36-40, 44, and 45 are rejected under 35 U.S.C. 103(a) as being unpatentable over Barton (US 2003/0157397), as evidenced by Yoshida (US 2003/0091891), in view of Larson (US 2003/0134178) and Andrews (US 2002/0110714).

Barton discloses a fuel cell comprising a cathode gas and an anode gas. The fuel cell comprises a gas diffusion backing layer on a catalyst coated membrane. The

gas diffusion backing comprises a porous carbonaceous paper having randomly oriented fibrils. The gas diffusion backing further comprises a microporous layer adjacent the porous carbonaceous paper. The microporous layer consists essentially of a fluorinated polymer that contains carbon particles [0050, 0055]. The carbon particles can comprise graphite fibers [0069]. The fluorinated polymer comprises poly(vinylidene fluoride) and PTFE [0060]. Carbon particles can be of any form that include, but not limited to Vulcan ® XC72, SP Carbon & Ensaco, and Applied Science Graphite Fibers with an average surface area of about 50 to 800 m2/g [0069].

Although Barton discloses an average surface area of about 50 to 800 m2/g [0069], Barton does not disclose that the surface area is above 750 m2/g (applicant's claim 36). Barton discloses that carbon particles are used to impart good electrical conductivity [0069]. Barton further discloses that the selection of the particular carbon particles (e.g., size and aspect ratio) will influence the level of porosity, coating thickness, and conductivity, as will be appreciated by those skilled in the art. In general, thinner coatings and larger pore sizes will promote mass transport across the coating. The formation of very large pores, however, tends to result in diminished contact between the carbon particles of the microporous layer and active regions of the catalyst, and thus reduces efficiency of a fuel cell for a given loading of carbon particles. Namely, there will be a need to employ routine experimentation to optimize the microporous layer for a particular application. [0083]. The surface area is directly related to particle size and Barton clearly discloses that the particle size is a result effective variable. It has been held by the courts that discovering an optimum value or

workable ranges of a result-effective variable involves only routine skill in the art, and thus not novel. *In re Boesch*, 617 F.2d 272, 205 USPQ 215 (CCPA 1980). See MPEP 2144.05. Further, it has been held by the courts that where the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation. In re Swain et. al., 33 CCPA 1250, 156 F.2d 239, 70 USPQ 412.

Barton discloses that the mean particle size of carbon Vulcan XC70 is about 30 nm, as evidenced by Yoshida [0131], but Barton does not disclose that the mean particle size is less than about 20 (claim 36). However, Larson teaches that carbon particles can be used for diffusion layer with typically having an average particle size of 1-100 nm [0027]. Larson teaches that the gas diffusion membrane must be conductive yet must be able to allow the passage of reactant and product fluids [0019]. Further, the particle size correlates with surface area, and thus reactive sites, as disclosed by Barton [0083]. Thus, it would have been obvious to one of ordinary skill in the art at the time the invention was made to adjust the carbon particle size for the benefit of easily mixing the microporous layer mixture and ultimately adjusting the particle size to control fluid passage and the reactive surface area as appropriate. Further, it would have been obvious to one of ordinary skill in the art at the time the invention was made to make the particle size less than 20 nm for the benefit of tightly packing the carbon particles.

Barton does not disclose that the microporous layer comprises greater than 80% of the carbon component. However, Barton discloses that the microporous layer comprises about 1 to 40 wt% carbon particles (applicant's carbon component), 1 to 20

wt% fluorinated polymer, and the balance being the dispersant or a solvent [0080]. Further, Barton discloses that typically, carbon particles are used to impart good electrical conductivity to the second layer (Barton's microporous layer) of the gas diffusion backing [0069]. It is clear that the amount of carbon particles affect the conductivity of the gas diffusion layer and thus, it would have been obvious to one of ordinary skill in the art at the time the invention was made to vary the carbon particle amount (applicant's carbon component) proportionally to appropriately control the conductivity (applicant's claims 44, 45). It has been held by the courts that where the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation. In re Swain et. al., 33 CCPA 1250, 156 F.2d 239, 70 USPQ 412.

Barton does not disclose that microporous layer infiltrates into the carbon paper to a depth of less than 5 um or 10 um. However, Barton discloses that the microporous layer will be coated or laminated directly onto the carbonaceous paper, and thus, be in electrically conductive contact [0055]. Further, since the carbon fibrous paper is porous, the microporous layer must necessarily microscopically infiltrate into the carbonaceous paper. Since Barton discloses that good electrical conductive contact must be present between the microporous layer and the carbon paper, it would have been obvious to one of ordinary skill in the art at the time the invention was made to vary and adjust the amount of infiltration for the benefit of attaining good adhesion between the two layers (applicant's claims 39, 40).

The microporous layer in the gas diffusion backing so formed has a thickness of about 1 to 100 microns (applicant's claims 38), and a coating weight of a fluorinated polymer of 0.1 to 20 mg/sqcm. In order to be useful in fuel cells, the layer so formed has a network of open micropores providing channels for the passage of water and reactant gases from one side to the other. Typically the micropores will constitute about 50% to about 85% of the layer, by volume, and have a mean pore size in the range of about 0.01 to about 5 microns [0082].

Barton does not disclose a controller configured such that the relative humidity of said humidified reactant product exceeds about 150% (claim 1) and 100% (claim 27). However, Andrews teaches humidification of the fuel gas and oxidant gas is generally required for fuel cells that use solid polymer electrolyte membranes [0003]. Andrews teaches an apparatus for controlling the humidity of a gas stream such as a reactant gas stream and a fuel gas stream used in fuel cells. The specific water evaporation rate, gas delivery temperature, and the degree of gas humidity may be adjusted and maintained at predetermined levels [0023]. The amount of water vapor available for absorption by the gas steam can be varied up to the saturation point [0024]. It would have been obvious to one of ordinary skill in the art at the time the invention was made to add Andrews' apparatus to Barton's fuel cell for the benefit of better controlling the humidity of the fuel cell.

Claims 41-43 are rejected under 35 U.S.C. 103(a) as being unpatentable over Barton (US 2003/0157397) in view of Andrews (US 2002/0110714), as evidenced by Yoshida (US 2003/0091891), further in view of Larson (US 2003/0134178) as applied to claim 36, further evidenced by Cipollini (US 6379827).

Barton and Larson disclose all the elements of claim 36. Barton discloses using Toray TGP-H-060. It is evidenced that Toray TGP-H-060 has porosity of about 65-75% and has a mean pore size of about 27 to 37 microns (applicant's claims 41 and 43), by Cipollini (5:30-45). Toray TGP-H-060 has a bulk density of 0.46 g/ml, a gas permeability of 30 mm Aq/mm, and an average thickness of about 180 microns (applicant's claim 42) [Barton, 0096].

Response to Arguments

Applicant's arguments filed 10/6/2006 have been considered but are moot in view of the new ground(s) of rejection.

Conclusion

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the

shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Cynthia Lee whose telephone number is 571-272-8699. The examiner can normally be reached on Monday-Friday 8:30am-5pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's trainer Susy, Tsang-Foster can be reached on 571-272-1293. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

ckl

Cynthia Lee

Patent Examiner

Susy Tsang-Foster

SUSY TSANG-FOSTER
PRIMARY EXAMINER